



Multicell and Dismount Command and Control — Tomorrow's Battle Command Environment Today

James Barbarello, Maureen A. Molz and Gary Sauer

Since the first experiments at Fort Hood, TX, in the early 1990s, the Army has been steadily moving battle command technology out of the industrial age and toward the information age. But what about the marriage of future battle command technology and its most important aspect — the art of battle command? It's the human element, not machine, that has and will always apply "art" to making life-and-death decisions involving Soldiers. Commanders can be aided by technology, but until the Multicell and Dismount Command and Control (M&D C2) program, they were never able to experiment with, and objectively measure, how a change to how and what they do affects the outcomes.

The challenges facing battlefield commanders are as dynamic as the world we live in. Diverse operating environments and modes of enemy tactics and weapons, coupled with increased operations tempo, are placing unprecedented demands on the Soldiers at the "tip of the spear." M&D C2 will better prepare commanders and Soldiers alike in the "art of battle command." Here, SGT Stephen Edwards and his fellow Alpha Co. troops from the 579th Engineer Battalion conduct cordon search and seizure operations in support of *Operation Grizzly Forced Entry*, August 21, 2004, in Iraq. (DOD photo by TSGT Scott Reed (Combat Camera).)

For decades, being able to try different battle command strategies, tactics, techniques and procedures in an objectively accurate and richly simulated environment has been the C2 community's Holy Grail. As former Secretary of the Army Thomas E. White put it, the fully realized capability stemming from such experimentation represents the "key to the universe" of battle command. That capability has now been realized in the Joint Defense Advanced Research Projects Agency (DARPA) Army M&D C2 program.

Future Combat Systems (FCS) C2

Throughout the 1990s, the Army experimented with, and began to implement, force digitization. The Army began applying computer technology and applications to the military decision-making process (MDMP) for the various battlefield functional areas (BFAs), which were brought online one-by-one and eventually interconnected to create the Army Battle Command System (ABCS). Simultaneously, within the Army's science and

technology (S&T) community, work progressed toward ABCS evolution. The S&T community was also looking at how the art of battle command could be enhanced by improved C2 technology.

While all this research and development (R&D) provided significant benefits to the Army, no one was focusing on the post-ABCS environment and how FCS was going to work at lower-echelon commands. The reason was simple — there was no MDMP or C2 experimentation capability.

In fall of 2000, DARPA and the Army joined forces to tackle this problem head-on. The list of participants and advisors reads like a "who's who" of industry and the military. Heavy-hitters like Lockheed Martin, Computer Sciences

Corp. (CSC), Science Applications International Corp. (SAIC) and MITRE Corp. worked alongside smaller innovative companies like Viecore Federal Systems Division (FSD). Retired general officers and Senior Executive Service members from the program executive offices (PEOs) and S&T communities served as a senior advisory board for Gary Sauer, the DARPA Project Manager (PM), and Maureen Molz, Deputy PM, along with members from the Army's PEO/PM, S&T, U.S. Army Training and Doctrine Command (TRADOC) and R&D communities. The resultant program — FCS C2 — ran from October 2000 through May 2003. As detailed in their *Military Review* article titled "DARPA's Future Combat Systems Command and

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Control" (May-June 2003), authors LTC Jack Gumbert II, LTC Ted C. Cranford, LTC (R) Thomas B. Lyles Jr. and LTC David S. Redding remarked that "no other C2 project has progressed as far on the development pathway to the transformed Army's future needs."

More specifically, the program:

- Created the first execution-based battle command prototype software for the Future Force — Commanders Support Environment (CSE) — with integrated BFA operational instructions and a reduced staff using a microcosm of a combined-arms unit of action.
- Created a laboratory environment that supports battle command software, rapid prototyping and testing.
- Executed five successful experiments

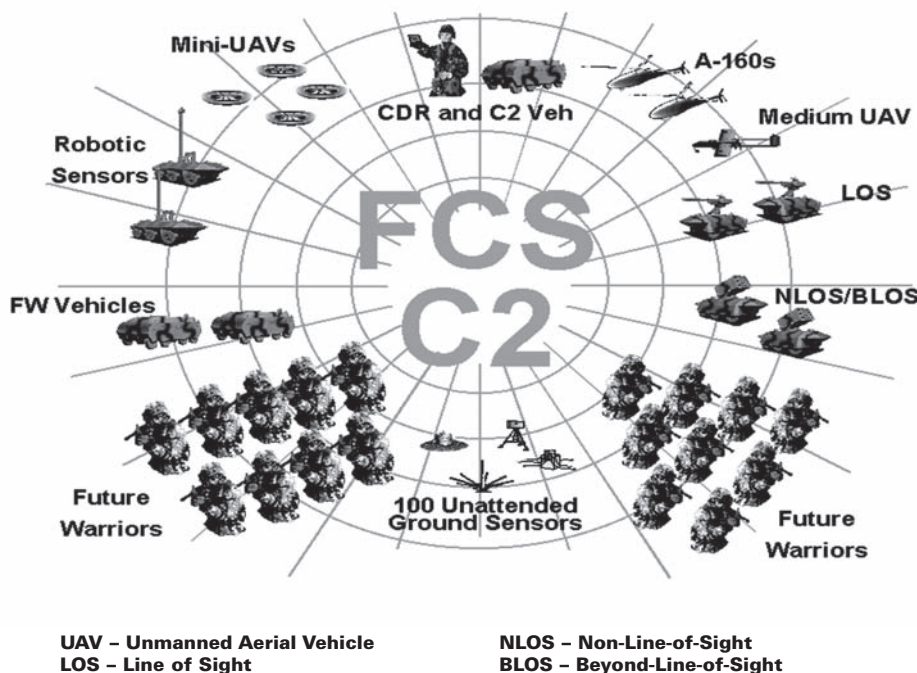
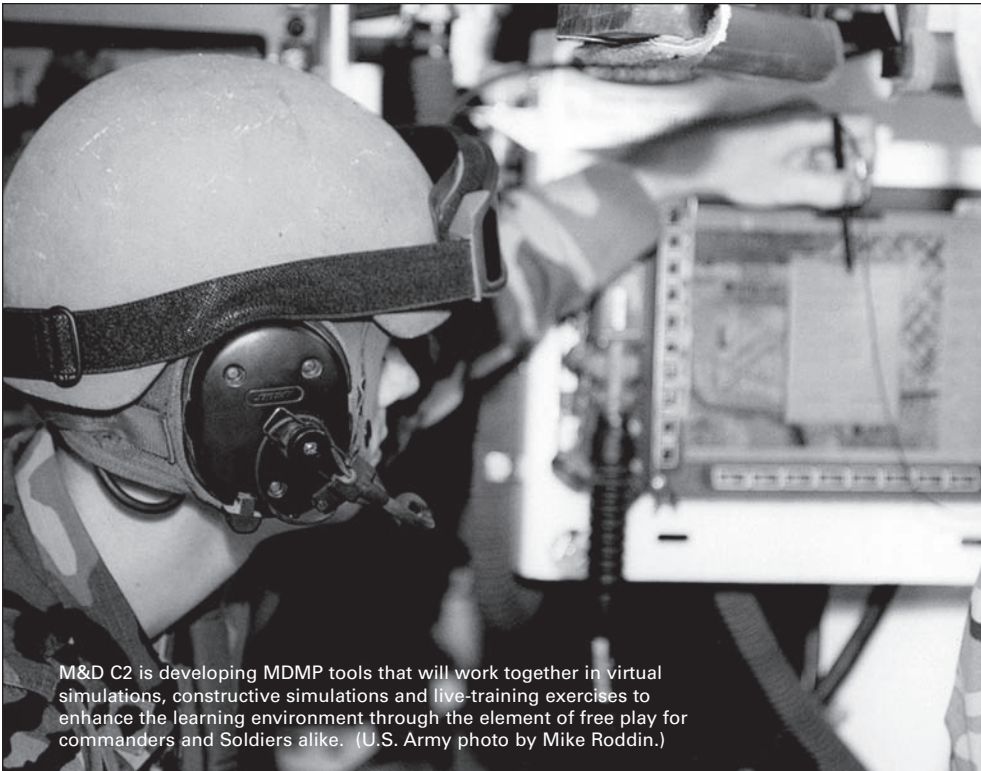


Figure 1. Organization of the unit cell



M&D C2 is developing MDMP tools that will work together in virtual simulations, constructive simulations and live-training exercises to enhance the learning environment through the element of free play for commanders and Soldiers alike. (U.S. Army photo by Mike Roddin.)

with military officers who fought against a thinking enemy and a tiger team that performed detailed experiment analysis.

- Brought warfighters and technologists together to design solutions for future battle command.

M&D C2

As monumental an accomplishment as it was, the FCS C2 program went only part of the way. FCS C2's environment was a "unit cell" as depicted in Figure 1 — in DARPA parlance, a combined-arms experimental organizational element not to be confused with any FCS program echelon. To find out how to empower decision makers in a network-centric environment like the FCS program plans to bring to the Army, a multicell or multiechelon experimental environment was needed. Dismounts, their next echelon and the next echelon above them would be ideal. In October 2003, the Army and DARPA again embarked to break new ground with the M&D C2 program. This 30-month program completed its first experiment at its Orlando, FL,

PEO for Simulation, Training and Instrumentation facility in October 2004.

What's Different?

Do a Google™ search on "command

and control" or "battle command software/simulation" and you'll get more than 140,000 hits. Among the results you'll find information about C2 systems for sale from some of the largest information technology companies, Joint C2 and tactical simulations organizations and other government organizations singularly focused on C2 or simulation. So what could the M&D C2 program represent that's in any way new? From an overview perspective, M&D C2 has developed tools that work together in virtual simulations — real people operating simulated systems — and constructive simulations — simulated people operating simulated systems. Like the real world, these scenarios are not scripted, allowing for the element of free play.

If we peek "under the hood," the main "engine" is the CSE as illustrated by Figure 2. It allows the people and simulations to interact. The dismounted infantry leader can interact

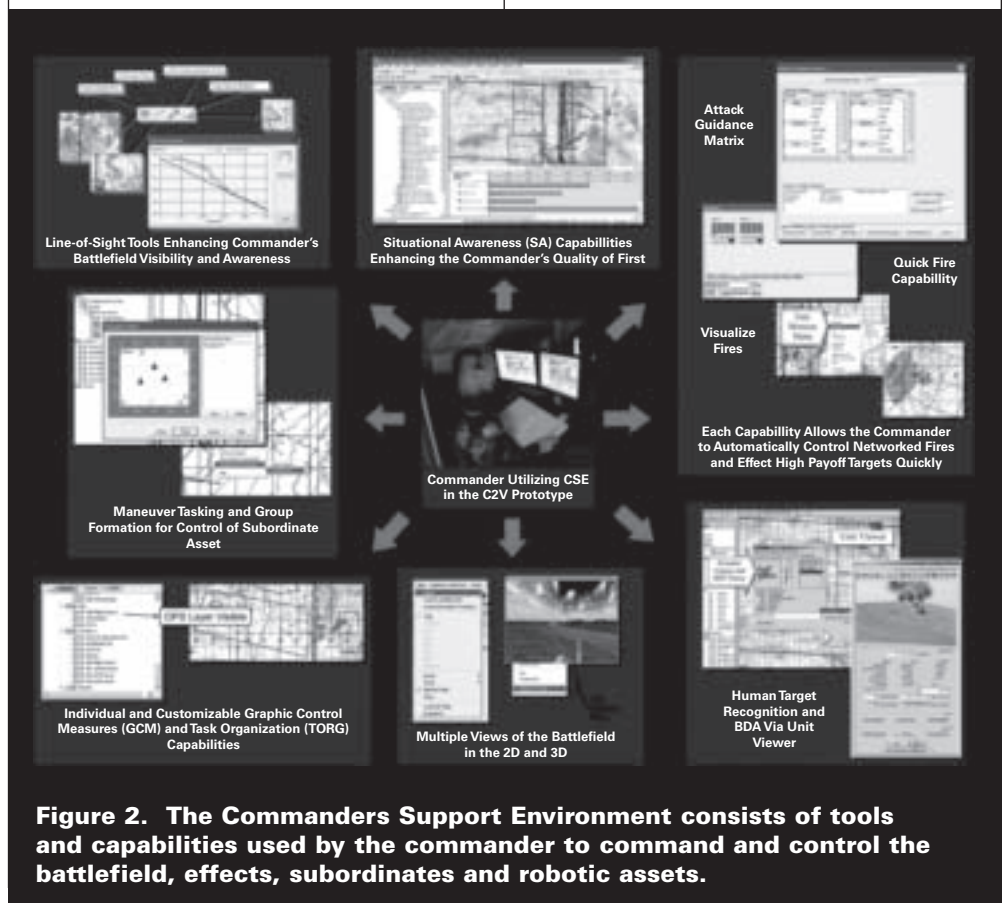


Figure 2. The Commanders Support Environment consists of tools and capabilities used by the commander to command and control the battlefield, effects, subordinates and robotic assets.

with the vehicle commander. At the same time, the commander can control robotic vehicles (constructive simulation) and interact with higher headquarters (virtual simulation) all in real time and in a nonscripted environment using C2 decision aids resident in the Collective Intelligence Module (CIM). The CIM is a knowledge base of rule sets that the experiment participants and system designers continually change and enhance as they glean new insights from experiment to experiment.

In the past, the CIM was a single entity. Now the CIM resides in every "cell" of the environment, from the simplest platform to the commander's nerve center. Thus, the CIM integrates a continuum of what's needed across a multicell structure. This construct makes it relatively easy to try out "what ifs" without having to rebuild the system each time. Likewise, it creates an operational environment used by real Army operators with real physics-based sensor models integrated with the OneSAF Testbed Baseline (OTB) in real, unscripted battle play.

Experiment 5

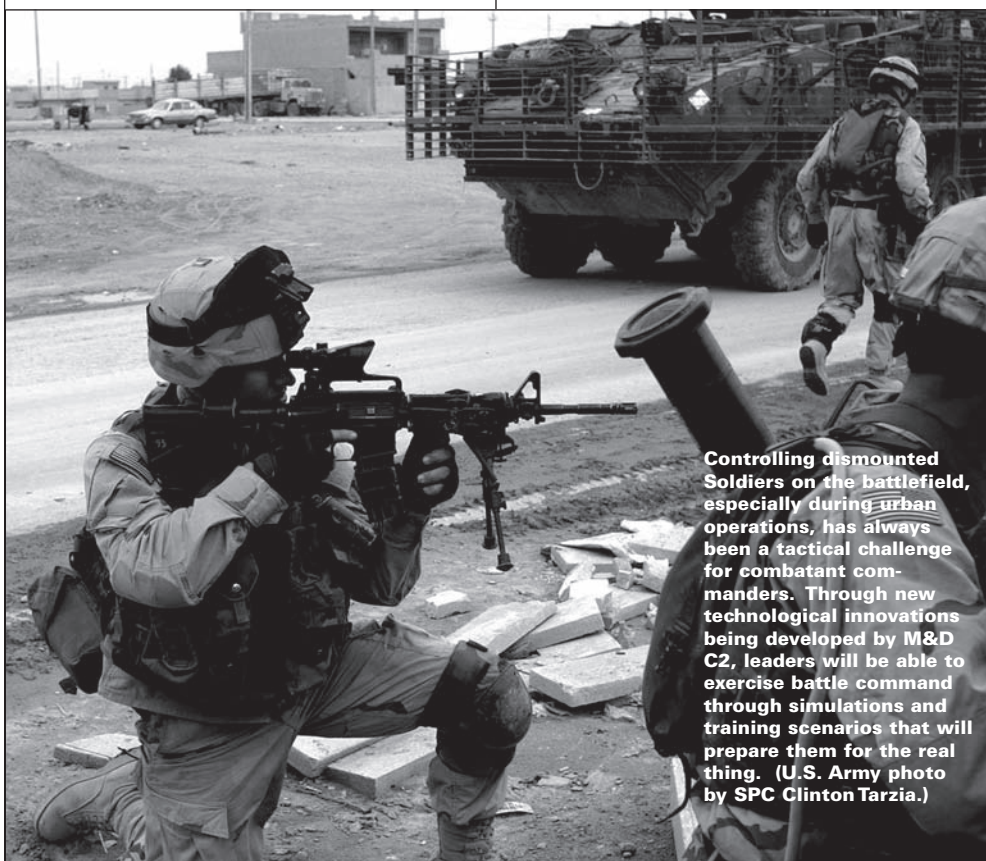
Experiment 5, conducted in Orlando in October 2004, was a significant first step in understanding the challenges that lie ahead for battle command across multiple echelons down to the individual Soldier. It was the first time a constructive and virtual world were linked together with a fully collaborative, expert system-enabled C2 device. Experiment 5 consisted of one run

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(battle) per day for 8 days. During each run, data were automatically obtained from the CSE, OTB and CIM logs, manually from 10 observers, from videotape footage of the complete battle and from the formal after action reviews (AARs) that were held after every two runs. Each run ran for more than 2 hours with one running more than 3 hours continuously. Fighting against the 21 "blue cell" experiment participants was a "red cell" (opposing force) of seven players. The blue cell consisted of a combined-arms (CA) unit commander and staff (three officers and one noncommissioned officer), a dismounted force with an infantry leader (senior

sergeant) and two squads. One squad contained a squad leader and a virtual squad. The other squad contained a squad leader and future warriors immersed in a virtual environment.

During Run 7, the CA unit had 1 hour to attack and clear an objective of insurgent forces so that follow-on forces could move to the east. During the run, the unit secured an objective to prevent its use by insurgents. The environment contained multiple elements of civilian infrastructure like national monuments, displaced persons camps, cemeteries, mosques and civilian bus routes. This Caspian Sea scenario included the Nagorno Karabakh Internal Liberation Organization (neutral force), Azeri Islamic Brotherhood (insurgent force) and the 44th Azeri Motorized Rifle Battalion. Terrain included an automated maneuver network provided by the Topographic Engineering Center with forested areas, swamps, fordable and non-fordable water obstacles and multiple soil types.



Controlling dismounted Soldiers on the battlefield, especially during urban operations, has always been a tactical challenge for combatant commanders. Through new technological innovations being developed by M&D C2, leaders will be able to exercise battle command through simulations and training scenarios that will prepare them for the real thing. (U.S. Army photo by SPC Clinton Tarzia.)

ABCS interconnected the various BFAs digitally during the 1990s. Today, the S&T community is attempting to enhance the art of battle command through improved C2 technology. (Photo courtesy of DOD.)



The environment was linked to a battalion from the Kura Brigade (subverted regular forces). There were also red cell weapons caches, headquarters and training camps to contend with during the virtual battle run.

It's Yours for the Asking (Well, Almost)

The Army/DARPA S&T investment of more than \$50 million has resulted in the most robust facility anywhere for conducting virtual and constructive simulation-based multicell battle command experimentation. The M&D C2 facility provides the Army community with an opportunity to participate and influence what will be examined and what will be learned. Experiment 6 will be conducted this summer.

Experiment 7, scheduled to begin in January 2006, has a wide-open agenda

for potential participants. Whether you play or not, the M&D C2 program continually arranges visits to the facility.

The CIM is a knowledge base of rule sets that the experiment participants and system designers continually change and enhance as they glean new insights from experiment to experiment.

Past visitors include the previous Secretary of the Army and Army Chief of Staff, DARPA Director, numerous senior-level Army military and civilian leaders, several strategic and operational players from the Boeing-SAIC FCS program team and key players from other services, academia and industry. For more information, contact authors Maureen Molz at (407) 208-3460 or via e-mail at Maureen.A.Molz@us.army.mil or James Barbarello at

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- Battle Command Battle Lab, Fort Leavenworth, KS — LTC Frederick Harper, frederick-harper@us.army.mil, (913) 684-2375, <http://www.leavenworth.army.mil>.
- TRADOC Analysis Center, Fort Leavenworth, KS — Pam Blechinger, blechinp@trac.army.mil, (913) 684-9120, <http://www.trac.army.mil>.
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- U.S. Army Communications-Electronics Command's (CECOM's) Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ — Steve Oshel, steven.oshel@us.army.mil, (732) 427-8071, <http://www.monmouth.army.mil/cecom/rdec/about.htm>.
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- Soldier Battle Lab, Fort Benning, GA (Experiment 5) — COL Mike Burns, burnsm@benning.army.mil, (706) 545-7000, <https://www.infantry.army.mil/sbl/index.htm>.
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Industry

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- Viecore FSD, Eatontown, NJ — Richard Bormann, **rbormann@viecorefsd.com**, (732) 691-1399, <http://www.lviecorefsd.com>.

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- CSC, Eatontown, NJ — Mark Berry, **mberry@csc.com**, (732) 460-2170, <http://csc.com>.

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- Johns Hopkins University-Applied Physics Laboratory, Baltimore, MD — James Hillman, **james.hillman@jhuapl.edu**, (240) 228-5000, <http://jhuapl.edu>.

- Lockheed Martin, Camden, NJ, and Bellevue, WA — Dale Miller, **dale.d.miller@atl.lmco.com**, (425) 957-3259, <http://www.atl.lmco.com/>.

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 - The MITRE Corp., Eatontown, NJ — Stephen Kirin, **kirin@mitre.org**, (732) 996-4531, <http://www.mitre.com>.
- Opposing Force:
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GARY SAUER has more than 22 years of diversified experience in program management, operations, strategic planning and technology transfer implementation for complex systems. Likewise, he has been instrumental in authoring C2 doctrine and assessing its use in operational and Joint environments. While at DARPA he held the position of Special Assistant to the Director, Operational Liaison, Director Office of Management Operations and Program Manager. Sauer holds a B.S. in civil engineering from the U.S. Military Academy, an M.S. in business administration from Central Michigan University Graduate School of Business and an M.M.A.S. in strategic and operational theory from the School of Advanced Military Studies, Fort Leavenworth, KS. He is a senior executive fellow of the John F. Kennedy School of Government, Harvard University, and a national securities fellow at the Massachusetts Institute of Technology. Sauer is also a member of the Military Operations Research Society.

